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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/670,251	09/26/2000	Mukund Padmanabhan	YOR92000390	5892

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FERENCE & ASSOCIATES
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EXAMINER	
LERNER, MARTIN	
ART UNIT	PAPER NUMBER
2626	

DATE MAILED: 09/01/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	09/670,251	PADMANABHAN ET AL.
	Examiner	**Art Unit**
	Martin Lerner	2626

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *04 August 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1 to 19* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1 to 15* is/are rejected.

7)☒ Claim(s) *16 to 19* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 1, 7, 8, 14, and 15 are rejected under 35 U.S.C. 102(b) as being anticipated by *Woodland et al. ("Iterative Unsupervised Adaptation Using Maximum Likelihood Linear Regression")*.

Regarding independent claims 1, 8, and 15, *Woodland et al.* discloses a method, apparatus, and computer program for adaptation in speech recognition, comprising:

"providing at least one speech recognition model" – gender independent Hidden Markov Models (HMMs) HMM-1 and HMM-2 are built from acoustic training data sets consisting of 36,493 sentences (Page 1134, Left Column, Paragraphs 4 to 7; Page 1135, Right Column, Paragraph 3);

"accepting speaker data" – test H3-P0 data was captured for each speaker of 20 speakers (Page 1134, Right Column, Paragraph 7);

"generating a word lattice having a plurality of paths based on the speaker data" – H3 development test data is used for lattice generation (Page 1135, Left Column, Paragraphs 3 to 5: Table 1); word lattices are used to generate an error rate for H3-P0

data (Page 1136, Left Column, Lines 1 to 6: Table 3); implicitly, a word lattice has a plurality of paths;

"wherein the step of generating the word lattice comprises considering language model probabilities by incorporating the language model probabilities into a transition probability" – the HTK LVCSR system uses a decoder to produce word lattices containing language model information for the application for rescoring of new language models (Page 1134, Left Column, Paragraph 8); lattices generated by the HTK system contain a set of nodes that correspond to particular instants and arcs connecting these nodes that represent hypotheses for the time period between the two nodes; associated with each arc are both language model and acoustic model scores; lattices may contain copies of each word, and further copies can be required to encode the language model constraints (Page 1135. Left Column, Paragraph 2); inherently, language models comprise a set of "language model probabilities" (*Wikipedia*: Language model), and arcs are paths through the lattice representing transition probabilities between words (*Wikipedia*: Hidden Markov model);

"adapting at least one of the speaker data and the at least one speech recognition model with respect to the generated word lattice in a manner to maximize the likelihood of the speaker data" – language models were trained on the text training corpus and the H3 text data sets; HMM-1 models used global MLLR adaptation and specific MLLR adaptation from word lattices for H3-P0 data; the result is a decreased error rate by adapting HMM-1 ("speech recognition model") to H3 data ("speaker data")

using MLLR (Maximum Likelihood Linear Regression) (Page 1135, Right Column, Paragraph 5 to Page 1136, Right Column, Paragraph 2: Table 3).

Regarding claims 7 and 14, *Woodland et al.* discloses maximum likelihood linear regression (MLLR) for adaptation of speaker data in speech recognition (Page 1133).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 2 to 6 and 9 to 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Woodland et al.* in view of *Nguyen et al.*

Concerning claims 2 and 9, *Woodland et al.* discloses generating word lattices, but omits generating word lattices by maximum a-posteriori adaptation. However, *Nguyen et al.* teaches adaptation by both Maximum Likelihood Linear Regression (MLLR) and Maximum A Posteriori (MAP) adaptation, noting that both techniques are available to perform adaptation. It is stated that Bayesian-based MAP techniques are particularly useful in dealing with adaptation of sparse data sets, but in practical applications, depending upon the amount of adaptation data available, a combination of both MLLR and MAP may be used. (Column 1, Lines 50 to 60) Thus, *Nguyen et al.* performs adaptation with both MLLR and MAP. (Column 3, Line 57 to Column 4, Line 32) It would have been obvious to one having ordinary skill in the art to generate a

word lattice with maximum a posteriori adaptation as taught by *Nguyen et al.* in MLLR adaptation with word lattices of *Woodland et al.* for the purpose of dealing with adaptation of sparse data sets in H3 training data.

Concerning claims 3 and 10, *Nguyen et al.* discloses Bayesian adaptation by MAP with Equation 4; γ is the observed posterior probability of the observation to adapt the speech models ("posterior state occupancy probability"); μ_{MAP} is found by summing the observed posterior probabilities over time: $\Sigma\ \gamma(t)\ o_t$ and $\Sigma\ \gamma(t)$ ("posterior word occupancy probabilities by summing over all states interior to a word") (column 4, lines 10 to 23); the adaptation system then processes the segments in an N-best pass to collect the most probable labels; model adaptation may be performed to adapt speech models to words ("at least one likely word at each frame") (column 3, lines 1 to 8; column 3, lines 47 to 56).

Concerning claims 4 and 11, *Woodland et al.* discloses word lattices (Page 1135, Left Column); a word lattice implicitly contains word traces.

Concerning claims 5 and 12, *Woodland et al.* discloses pruning during adaptation (Paragraph Bridging Pages 1135 to 1136), but does not expressly discard interpretations associated with low confidence. However, *Nguyen et al.* teaches assigning weights to the N-best transcriptions, so that reliable information becomes enhanced by a positive weight, and unreliable information is correspondingly diminished by a negative weight. The system thus tends to push models that generate incorrect labels away from those that generate correct ones. Subsequently, model information is accumulated among the N-best transcriptions for the entire set of sentences and then

used to adapt the speech models. (Column 3, Lines 32 to 56; Column 4, Lines 23 to 59) Taking the N-best of the most reliable transcriptions necessarily implies eliminating transcriptions not associated with the N-best most reliable transcriptions ("discarding interpretations associated with low confidence"). N-best techniques are well known in speech recognition. *Nguyen et al.* says assigning weights to the N-best transcriptions corresponding to their likelihoods produces a natural information and data corrective process. (Column 3, Lines 31 to 34) It would have been obvious to one having ordinary skill in the art to utilize the N-best technique of *Nguyen et al.* to discard unreliable transcriptions for pruning in MLLR adaptation with word lattices of *Woodland et al.* for the purpose of producing a natural information corrective process.

Concerning claims 6 and 13, *Nguyen et al.* discloses Bayesian adaptation by MAP with Equation 4; γ is the observed posterior probability of the observation to adapt the speech models ("posterior phone probability") (column 4, lines 10 to 23); the observations and labels represent phonemes in speech recognition.

Allowable Subject Matter

5. Claims 16 to 19 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Response to Arguments

6. Applicants' arguments filed 04 August 2006 have been fully considered but they are not persuasive.

Applicants argue that *Woodland et al.* fails to disclose the limitation of "generating a word lattice having a plurality of paths based on the speaker data, wherein the step of generating the word lattice comprises considering language model probabilities by incorporating the language model probabilities into a transition probability." Applicants say that *Woodland et al.* teaches generation of a word lattice by calculating language model and acoustic model scores, and consideration is to language model scores and not transition probabilities. Applicants cite *Woodland et al.*, Page 1135, Left Column, ¶ 2, as disclosing language model and acoustic model scores, implying that scores exclude transition probabilities. This position is not persuasive.

Woodland et al. discloses word lattices incorporating knowledge of language models having arcs connecting nodes that represent word hypotheses, where the arcs represent transition probabilities between words. (5. Lattice Generation Experiments: Page 1135, Left Column, ¶'s 1 and 2) Inherently, the arcs of a word lattice represent transition probabilities between the words of the lattice.

Woodland et al. states that a tree structured network decoder can be used to produce word lattices containing both language model and acoustic information, and can be used for rescoring with new acoustic models, or for the application of new language models. (2. HTK Recognition System, Page 1134, Left Column, ¶ 8) Thus, it

should be clear to one having ordinary skill in the art that the rescoring, in a context disclosed by *Woodland et al.*, refers to the adaptation of the acoustic and language models to produce new acoustic and language models. It is maintained that any terminological distinction between transition probabilities and scores corresponds to a state of the lattice and the testing of the lattice, respectively.

However, the arcs of the lattice represent transition probabilities, inherently, for *Woodland et al.* Numerous patent references can be produced to show that a lattice inherently involves transition probabilities along arcs between nodes. Official notice is taken that lattices for speech recognition inherently involve transition probabilities between nodes of the lattice. (See, *e.g.*, *Wikipedia,* "Hidden Markov model"; U.S. Patent No. 4,980,918 to *Bahl et al.*, Column 18, Line 63 to Column 20, Line 56: Figures 9 and 20; and U.S. Patent No. 6,411,929 to *Ishiwatari et al.,* Column 5, Line 13 to Column 6, Line 63: Figures 5 and 6.) Thus, transition probabilities are inherent features of hidden Markov models, and the arcs between the nodes of the word lattice inherently represent transition probabilities in *Woodland et al.*

Therefore, the rejections of claims 1, 7, 8, 14, and 15 under 35 U.S.C. 102(b) as being anticipated by *Woodland et al.*, and of claims 2 to 6 and 9 to 13 under 35 U.S.C. 103(a) as being unpatentable over *Woodland et al.* in view of *Nguyen et al.*, are proper.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to Applicants' disclosure.

Wikipedia, "Hidden Markov model" discloses that a sequence of states in a hidden Markov model has transition probabilities between the states.

Bahl et al. ('918) discloses that a trellis, or lattice, has arcs representing transition probabilities between nodes.

Ishiwatari et al. discloses that a trellis has transition probabilities. (Column 5, Line 13 to Column 6, Line 63: Figures 5 and 6)

8. **THIS ACTION IS MADE FINAL.** Applicants are reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Martin Lerner whose telephone number is (571) 272-

7608. The examiner can normally be reached on 8:30 AM to 6:00 PM Monday to Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David R. Hudspeth can be reached on (571) 272-7843. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

ML
8/29/06

Martin Lerner
Examiner
Group Art Unit 2626